

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : **10-308277**  
 (43)Date of publication of application : **17.11.1998**

(51)Int.CI.

**H05B 33/14**  
**C09K 11/06**

(21)Application number : **09-116979**  
 (22)Date of filing : **07.05.1997**

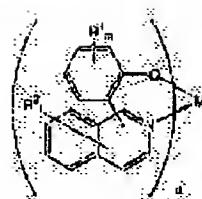
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## (54) ORGANIC ELECTROLUMINESCENT ELEMENT

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To increase the light emission luminance, and to improve the stability at the time of use by adding o-hydroxyphenyl isoquinoline compound as single or a mixture with other material to a layer to be pinched between a pair of conductive layers.

**SOLUTION:** o-hydroxyphenyl isoquinoline compound is expressed with a formula. In the formula, M means n-valency metal ion, R1, R3 means substituent or non-substituent alkyl group, a substituent or non-substituent aryl group, halogen group, nitro group, cyano group, aryl group, a substituent or non- substituent amino group, mercapto group, hydroxyl group, carboxyl group, a substituent or non-substituent alkoxy group, a substituent or non-substituent alkoxy carbonyl group. (n) means 1-4, (m) means 0-4, (l) means 0-6. A metal complex with various metal ion is formed so as to be used for any one of a light emitting layer 4, an electron transporting layer 5, a positive hole transporting light emitting layer 7 and an electron transporting light emitting layer 8.



### LEGAL STATUS

[Date of request for examination] **07.05.1997**

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number] **2940514**

[Date of registration] **18.06.1999**

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the organic electroluminescent (EL) element used for the flat-surface light source or a display device.

[0002]

[Description of the Prior Art] As for the EL element, promising \*\* of the use as a spontaneous light type flat-surface type display device is carried out. Development is briskly performed from the organic EL element which used the organic substance especially being an alternating current drive like inorganic [ EL ], and not having restrictions that the high voltage is required, and it being considered by the versatility of an organic compound for multiple-color-izing to be easy.

[0003] However, the conventional organic EL element had low luminescence brightness compared with the inorganic EL element, and since property degradation was remarkable, it had not resulted in utilization. In recent years, the organic thin film laminating type EL element with the high luminous efficiency which emits light by the low battery not more than 10V of an organic compound is reported, and admiration is collected (refer to applied physics Letters (Applied Physics Letters), 51 volumes, 913 pages, and 1987).

[0004] By this method, the fluorescent substance thin film layer and the amine system compound were used for the hole-injection layer for the metal chelate complex, green luminescence of high brightness has been obtained, several 100 cd/m<sup>2</sup> and the maximum luminous efficiency attain 1.51 lm/W by the direct current voltage of 6-7V, and brightness has a performance near a practical use field.

[0005]

[Problem(s) to be Solved by the Invention] The organic EL element by present is not given to still sufficient luminescence brightness, although luminescence brightness is improved by composition and the improvement of material. Moreover, what is the same and has sufficient stability for practical use also about the life of an element is not obtained. Therefore, the present condition is that development of the organic EL element which has stability at the time of bigger luminescence brightness and the outstanding use is desired.

[0006] Luminescence brightness is large and this invention aims at offering the organic EL element excellent in the stability at the time of use.

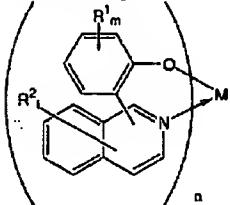
[0007]

[Means for Solving the Problem] This invention persons found out that the organic EL element which satisfied these requirements was obtained by making an organic EL element contain a specific compound, as a result of repeating examination wholeheartedly for luminescence brightness to be large and find out the composition of the organic EL element excellent in the stability at the time of use.

[0008] Namely, this invention aims at offering the organic electroluminescent element characterized by including o-hydroxyphenyl isoquinoline compound shown in the layer pinched between conductive layers between the conductive layers of a couple in the organic electroluminescent element which contains a luminous layer at least by the general formula (1).

[0009]

[Formula 2]



[0010] (M expresses the metal ion of n \*\* among a formula.) R1 and R2 The alkoxy carbonyl group which is not replaced [ the alkoxyl group which is not replaced / the amino group which is not replaced / the aryl group which is not replaced / the alkyl group which is not replaced / substitution or /, substitution, or /, a halogen, a nitro group, a cyano group, an allyl group, substitution, or /, a sulphydryl group, a hydroxyl, a carboxyl group, substitution, or /, substitution, or ] is expressed. n -- 1-4m -- 0-4l -- each of 0-6 -- it is shown any they are

[0011] Hereafter, this invention is explained in detail.

[0012] o-hydroxyphenyl isoquinoline used for this invention forms various metal ions and metal complexes. Especially the position of o-hydroxyphenyl machine is not limited. Although aluminum, magnesium, beryllium, silicon, a scandium, titanium, vanadium, chromium, manganese, iron, cobalt, nickel, copper, zinc, a gallium, a ruthenium, palladium, silver, cadmium, an indium, tin, a lanthanoids, and an actinoids are mentioned as a metal which forms a metal complex, it is not restricted to these.

[0013] The cross section of the example of structure of the organic EL element of this invention is typically shown in drawing 1-5. The conductive layer from which in an electron hole transporting bed and 4 a luminous layer and 5 become an electronic transporting bed, and 6 becomes [ the conduction layer from which 1 becomes a substrate and 2 becomes an anode plate, and 3 ] cathode, and 7 express the electron hole transportability luminous layer, and 8 expresses the electronic transportability luminous layer, respectively.

[0014] even if it uses for both a luminous layer 4 the electronic transporting bed 5 the electron hole transportability luminous layer 7 and the electronic transportability luminous layer 8 the metal complex expressed with the aforementioned general formula (1) -- high -- an organic EL element with high brightness stability can be obtained Moreover, if the aforementioned metal complex is contained in the luminous layer 4, the electronic transporting bed 5, the electron hole transportability luminous layer 7, or the electronic transportability luminous layer 8, it does not need to be contained in another layer in the same element.

[0015] A substrate 1 serves as a base material of the organic EL element of this invention, and the board of a quartz or glass, a metal plate, a resin film, a resin plate, etc. are used.

[0016] It is usually constituted by the conductive layer 2 used as the anode plate on a substrate 1 by metallic oxides, such as metals, such as aluminum, vanadium, iron, cobalt, nickel, a tungsten, palladium, a tellurium, silver, and gold, and those alloys, indium oxide, and tin oxide, copper iodide, carbon, or the conductive polymer. Although formation of a conductive layer is performed in many cases by the dry type forming-membranes methods, such as a vacuum deposition method and the sputtering method, a suitable binder resin solution is made to distribute the above-mentioned electrode material, and the wet forming-membranes methods, such as a dip coating method and the spin coat method, can also be used. Under the present circumstances, there is especially no limit in the solvent to be used. Furthermore, in the case of a conductive polymer, it is also possible to form a thin film on a direct substrate by the electric-field polymerization. This conductive layer can also be formed by two or more thin films.

[0017] Although it is possible to use the material for the aforementioned conductive-layer 2 for the conductive layer 6 used as cathode, since it is necessary to perform an electron injection efficiently, metals or those alloys, such as tin, magnesium, an indium, aluminum, and silver, are desirable. It is possible to form by two or more thin films as well as [ this conductive layer 6 ] a conductive layer 2.

[0018] When taking out the light which emitted light to conductive layers 2 and 6 although there was especially no limit in thickness in the direction perpendicular to a substrate, as for the translucent rate of one [ at least ] conductive layer, it is preferably desirable that it is 80% or more 60% or more. In this case, 5-1000nm of thickness is usually about 10-500nm preferably.

[0019] Various electron hole transportation material is used for the electron hole transporting bed 3. As this electron hole transportation material, while the injection efficiency of the electron hole from a conductive layer 2 is high, what also has the high capacity to convey an electron hole is desirable. As such an electron hole transportation material, various well-known electron hole transportation material is usable. For example, as a low-molecular material, aromatic-amine system compounds, hydrazone system compounds, etc., such as a triphenylamine and a screw triphenylamine, are mentioned. Moreover, as polymeric materials, a polyvinyl carbazole and the macromolecule which has the aromatic-amine system skeleton shown in JP,8-54833,A and JP,8-269133,A in a side chain are also usable. Moreover, inorganic material with electron hole transportability can also be used. Even if such material and a compound are independent, mixture can also use them. Moreover, it is possible to use also in the state where it was made to distribute in a suitable binder resin if needed. A polycarbonate, a polyarylate, polyester, etc. are mentioned as a binder resin. It is also possible to use macromolecule electron hole transportation material as a binder.

[0020] The above-mentioned electron hole transportation material is formed by the vacuum deposition method and the applying method. In order to raise electron hole transportability, hole-injection nature, and membrane formation nature in any case, you may add and use various additives.

[0021] Even when the metal complex material expressed with a general formula (1) is independent, its mixture with other materials is also usable. As a material to mix, various material is usable. Although coloring matter, such as fluorescence material, such as an anthracene, naphthalene, a stilbene, a tetrapod phenyl butadiene, a coumarin, biphenyls, and those derivatives, a benzofuran derivative, and a coumarin derivative, is raised when using for a luminous layer 4, it is not limited to these. Although inorganic electronic transportation material, such as metal complex compounds, such as organic electronic transportation material, such as an OKISA diazole derivative and a triazole derivative, and a quinolinol aluminum complex, n type hydrogenation amorphous silicon carbide, and n type zinc sulfide, etc. is mentioned when using for the electronic transporting bed 5, it is not limited to these. When using for the electron hole transportability luminous layer 7, it is possible to use both the material used for the electron hole transporting bed 3 and a material mixable to a luminous layer 4. When using for the electronic transportability luminous layer 8, it is possible to use both the material used for the electronic transporting bed 5 and the material used for a luminous layer 4.

[0022] A luminous layer 4, the electronic transporting bed 5, the electron hole transportability luminous layer 7, and the electronic transportability luminous layer 8 are formed by each by the same method as the electron hole transporting bed 3.

[0023]

[Embodiments of the Invention] Hereafter, although an example explains this invention still more concretely, this invention is not limited to the following examples, unless the main point is exceeded.

[0024] (Example 1-10 of manufacture)

1 -(o-hydroxyphenyl)- The isoquinoline was compounded according to Geissman's and others method (journal OBU organic chemistry, 11 volumes, 741 pages, 1946). 1 which contained the metal atom shown in Table 1 according to the technique (a journal OBU THE American chemical society, 74 volumes, 5239 pages, 1952) of W.D.Johnston and H.Freiser using this -(o-hydroxyphenyl)- The isoquinoline metal complex was compounded.

[0025]

[Table 1]

製造例	金属
1	アルミニウム
2	鉄
3	銅
4	クロム
5	亜鉛
6	ニッケル
7	コバルト
8	セリウム
9	ランタン
10	水銀

[0026]

[Example]

(Example 1) On the washed glass plate with an ITO electrode, vacuum deposition of the 4 and 4'-screw (N-(1-naphthyl)-N-phenylamino) biphenyl was carried out, and the electron hole transporting bed of 60nm of thickness was obtained. Subsequently, 1 -(o-hydroxyphenyl)- Vacuum deposition of the isoquinoline aluminum metal complex was carried out, and the 20nm luminous layer was obtained. Vacuum deposition of the 8-hydroxyquinoline aluminum metal complex was carried out on it, and the 50nm electronic transporting bed was obtained. Furthermore on it, the conductive layer of 200nm of thickness was formed with the alloy which mixed silver with magnesium by 10:1, and the organic EL element shown in drawing 1 was obtained. This element showed good organic EL luminescence property. Moreover, after carrying out continuation luminescence for 1000 hours, the first stage and the good luminescence property not changing were shown.

[0027] (Example 2-10) 1 -(o-hydroxyphenyl)- 1 which replaced with the isoquinoline aluminum metal complex and was obtained by the luminous layer in the examples 2-10 of manufacture -(o-hydroxyphenyl)- The organic EL element was produced by the same method as an example 1 except using an isoquinoline metal complex. Each of these elements showed good organic EL luminescence property. Moreover, after carrying out continuation luminescence for 1000 hours, the first stage and the good luminescence property not changing were shown.

[0028] (Example 11) On the washed glass plate with an ITO electrode, vacuum deposition of the 4 and 4'-screw (N-(1-naphthyl)-N-phenylamino) biphenyl was carried out, and the electron hole transporting bed of 60nm of thickness was obtained. Subsequently, 1 -(o-hydroxyphenyl)- Vacuum deposition of the isoquinoline aluminum metal complex was carried out, and the 50nm electronic transportability luminous layer was obtained. The conductive layer of 200nm of thickness was formed with the alloy which moreover mixed silver with magnesium by 10:1, and the organic EL element shown in drawing 2 was obtained. This element showed good organic EL luminescence property. Moreover, after carrying out continuation luminescence for 1000 hours, the first stage and the good luminescence property not changing were shown.

[0029] (Example 12-20) 1 -(o-hydroxyphenyl)- 1 which replaced with the isoquinoline aluminum metal complex and was obtained by the luminous layer in the examples 2-10 of manufacture -(o-hydroxyphenyl)- The organic EL element was produced by the same method as an example 11 except using an isoquinoline metal complex. Each of these elements showed good organic EL luminescence property. Moreover, after carrying out continuation luminescence for 1000 hours, the first stage and the good luminescence property not changing were shown.

[0030] (Example 21) On the washed glass plate with an ITO electrode, it is a 4 and 4'-screw (N-(1-naphthyl)-N-phenylamino) biphenyl and 1. -(o-hydroxyphenyl)- Vacuum deposition of the isoquinoline aluminum metal complex was carried out, and the electron hole transportability luminous layer of 60nm of thickness was obtained. Subsequently, vacuum deposition of the 8-hydroxyquinoline aluminum metal complex was carried out, and the 50nm electronic transporting bed was obtained.

Furthermore on it, the conductive layer of 200nm of thickness was formed with the alloy which mixed silver with magnesium by 10:1, and the organic EL element shown in drawing 3 was obtained. This element showed good organic EL luminescence property. Moreover, after carrying out continuation luminescence for 1000 hours, the first stage and the good luminescence property not changing were shown.

[0031] (Example 22-30) 1 -(o-hydroxyphenyl)- 1 which replaced with the isoquinoline aluminum metal complex and was obtained by the luminous layer in the examples 2-10 of manufacture -(o-hydroxyphenyl)- The organic EL element was produced by the same method as an example 21 except using an isoquinoline metal complex. Each of these elements showed good organic EL luminescence property. Moreover, after carrying out continuation luminescence for 1000 hours, the first stage and the good luminescence property not changing were shown.

[0032] (Example 31) On the washed glass plate with an ITO electrode, it is a 4 and 4'-screw (N-(1-naphthyl)-N-phenylamino) biphenyl and 1. -(o-hydroxyphenyl)- Vacuum deposition of the isoquinoline aluminum metal complex was carried out, and the electron hole transportability luminous layer of 70nm of thickness was obtained. Subsequently, the conductive layer of 200nm of

thickness was formed with the alloy which mixed silver with magnesium by 10:1, and the organic EL element shown in drawing 4 was obtained. This element showed good organic EL luminescence property. Moreover, after carrying out continuation luminescence for 1000 hours, the first stage and the good luminescence property not changing were shown.

[0033] (Example 32-40) 1 -(o-hydroxyphenyl)- 1 which replaced with the isoquinoline aluminum metal complex and was obtained by the luminous layer in the examples 2-10 of manufacture -(o-hydroxyphenyl)- The organic EL element was produced by the same method as an example 31 except using an isoquinoline metal complex. Each of these elements showed good organic EL luminescence property. Moreover, after carrying out continuation luminescence for 1000 hours, the first stage and the good luminescence property not changing were shown.

[0034] (Example 41) On the washed glass plate with an ITO electrode, vacuum deposition of the 4 and 4'-screw (N-(1-naphthyl)-N-phenylamino) biphenyl was carried out, and the electron hole transporting bed of 60nm of thickness was obtained. Subsequently, vacuum deposition of the tetrapod phenyl butadiene was carried out to 8-hydroxyquinoline aluminum metal complex, and the 20nm luminous layer was obtained. It is 1 on it. -(o-hydroxyphenyl)- Vacuum deposition of the isoquinoline aluminum metal complex was carried out, and the 50nm electronic transporting bed was obtained. Furthermore on it, the conductive layer of 200nm of thickness was formed with the alloy which mixed silver with magnesium by 10:1, and the organic EL element shown in drawing 1 was obtained. This element showed good organic EL luminescence property. Moreover, after carrying out continuation luminescence for 1000 hours, the first stage and the good luminescence property not changing were shown.

[0035] (Example 42-50) 1 -(o-hydroxyphenyl)- 1 which replaced with the isoquinoline aluminum metal complex and was obtained by the luminous layer in the examples 2-10 of manufacture -(o-hydroxyphenyl)- The organic EL element was produced by the same method as an example 21 except using an isoquinoline metal complex. Each of these elements showed good organic EL luminescence property. Moreover, after carrying out continuation luminescence for 1000 hours, the first stage and the good luminescence property not changing were shown.

[0036]

[Effect of the Invention] By this invention, the organic EL element which is high brightness and was excellent in stability can be obtained.

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[Translation done.]